Hydrologic Model Manager

Short Name	RiverWare 3.0
Long Name	

Description	RiverWare is a general modeling environment for operational management of multi-objective river and reservoirs systems.

Models are created and run through a user-friendly graphical user interface. The object-oriented approach provides a palette of objects which correspond to physical features in the basin such as reservoirs, river reaches, diversions, water users, groundwater, etc. The physical processes on each object are modeled according to specific algorithms selected by the user, based on time step size, data availability, desired resolution or an institutional need to use a particular method.In addition to water quantity, water quality algorithms model temperature, dissolved oxygen and TDS.

RiverWare's simulation algorithm solves upstream, downstream, or any will-determined combination of these in a single run. Input/output data combinations are flexible, allowing various combinations of, for example, storage, pool elevation, releases, energy and inflows as inputs to drive the simulation.

Rulebased simulation allows the specification of prioritized "if-then" operating policy statements to drive the simulation instead of input data values. The rules are easily written by the user in a language provided through the syntax-directed editor. Complex policy can be represented clearly and concisely by using a library of pre-defined or user-customize functions. The rules are interpreted and executed when the simulation needs additional data.

Water accounting module allows water types and water ownership to be tracked in the model in a network of accounts. Storage accounts, diversion accounts and flow accounts represent legal water accounts. Water rights, accruals, carry overs and exchanges can also be represented. Accounts can be solved "after the fact" or account data can be accessed to use in the operating rules to drive the simulation as well as the accounting solution.

The optimization solution using preemptive goal programming to trade off multiple objectives. The modeler enters a set prioritized policy objectives and constraints through a graphical constraint editor. These are automatically linearized according to user-selected linearization methods. Physical constraints such as mass balance, topological connections and upper/lower bounds are automatically generated by the objects. The linear program is generated for each goal and sent to a powerful, fast commercial solver. Objectives are met in order of priority, and the solution is returned to the objects.

The model has other features such as multiple run management, a data management interface (DMI) to tie it to data sources and sinks, batch mode, several output options and advanced diagnostic and model run analysis utilities. |

Model Type
Model Objectives
Agency Office
Tech Contact
Model Structure
Interception
Groundwater
Snowmelt

Precipitation	
Evapo-transpiration	
Infiltration	
Model Paramters	
Spatial Scale	from one reservoir to an entire basin (e.g. Colorado River Basin)
Temporal Scale	time step sizes available: 1 hour, 6 hours, 12 hours, 1 day, 1 week, 1 month, 1 year
Input Requirements	Simulation requires enough data to solve the system - some combination of inflows, releases, storages, elevations and water demands. All possible inputs are too numerous to list here. The data can be input directly by typing into the GUI, or read from files which have each time step's data on each line. Each slot (data structure associated with a variable or parameter) can read in data from a file directly (user initiates action through GUI), or the external DMI routines can read a file into a slot. Rulebased simulation runs and optimization runs require user-specified prioritized policy sets.
Computer Requirements	SUN Solaris, Windows NT (summer 2000).
Model Output	Output can be in the form of plots, text files and binary or comma-delimited files which can be read by Excel. Model output also appears in the slots on the objects and in the SCT, either of which can be printed. Parameters which can be plotted or displayed include, but are not limited to inflows, releases, storages, power generation and deliveries, etc.
Parameter Estimatn Model Calibrtn	
Model Testing Verification	
Model Sensitivity	
Model Reliabiity	Excellent reliability.
Model Application	
Documentation	Good documentation. Web based support ***************** The CADSWES web page http://cadswes.colorado.edu provides: - information about RiverWare - download and install procedures - download directly from web page - documents and technical papers in pdf - bug reporting facility - user support email access - training schedules
Other Comments	Model Strengths ************** - Build site-specific models quickly. - Can create automatic links to any database or external data sources. - Rules represent policies as dynamic data, which can be viewed and modified outside the compiled code. - Can see which policies resulted in specific releases, elevations, etc. - can easily modify the topology or operating policies without changing code. - enter data, run model, view results in spreadsheet-like interface (SCT) Model Weaknesses **************** - In some of the more complex rule based applications, execution times can be

rather slow. Solutions are being explored.
- Incomplete Documentation.

Additional Skills
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Some programming background is useful (but not strictly necessary) for
creating rulesets. As with most robust, state of the art modeling systems, not
everything is intuitive and some intensive training is required for the new user.
A training class (see below) is highly recommended for new users.
RiverWare's rule language is specific to RiverWare and
is taught in our training classes.

Training Opportunities
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CADSWES provides the following training classes:
Introduction to Simulation Modeling - a 3-day class
Introduction to Rulebased Simulation Modeling - a 3-day class
These are given several times a year (according to demand). See the
CADSWES web page for schedules http://cadswes.colorado.edu
An optimization modeling class is underdevelopment and will be
offered for the first time this year.

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Developer	
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Contact Organization	